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A NATURALIST'S YEAR.

By GRANT ALLEN.

XVII.—CRABS AND LOBSTERS.

AMONG the olive-green hanging seaweed that drops like a curtain from the landward side of this broken ledge of rock, I have just disentombed with my stick a little soft-shelled crab, who, bent on indulging his naturally retiring disposition, had taken refuge there in solitary security, when the tide began to leave his open feeding-grounds high and dry. See him scuttle hastily sideways now across the bare patch of beach, and make his way with all convenient speed towards the neighbouring pool, where he proceeds at once to bury himself, tail foremost, once more under the wet sand beneath the overhanging eaves of the ledges! How fast and how clumsily he runs! How quickly and yet how awkwardly he grubs his way into the yielding quicksands! A crab always suggests to one the notion of an animal that has not quite fully adapted itself to the conditions under which it is living. It seems to have learnt the trick fairly well, so to speak, but not to be able to perform it with perfect grace and ease. This is a feeling one often has about creatures which have widely diverged in habit, and especially in attitude, from the rest of their kind. They always seem to be clumsy in their movements. One notices it, among birds, in the penguin, the puffins, and many other erect species, as well as in the waddling of ducks; or among mammals, in the seals and their congeners, as well as in the kangaroos and jerboas. Nay, even man himself has something of the same awkwardness about him, for though he can walk well enough, he can't squat or sit gracefully without the aid of an artificial mechanism, such as a chair or a sofa. In all these cases, we may fairly say that the peculiar modification of the ancestral type for a special purpose has entailed a certain necessary clumsiness in other matters, because the original limbs were fitted for different ends from those to which they are now applied. The clumsiness is due, in fact, to what one may describe as patching and altering on the part of Nature.

The crab is an excellent example of such natural afterthoughts. By descent all crabs are, roughly speaking lobsters; or, to put it more correctly, both crabs and lobsters are derived from a single common ancestral form, from which the crab has diverged a great deal, while the lobster has diverged relatively little. Crabs, in fact, may be approximately described as the kind of lobsters that has taken to walking instead of swimming and jumping. If you compare a lobster with any one of its less developed relations, such as a prawn or a shrimp, you will see that while they differ in many important points of structure (which I leave aside, as belonging rather to the province of professional biologists, like Dr. Wilson, than of mere strolling field naturalists like myself), they agree in certain general proportions of the most conspicuous external parts. They have all long, large muscular tails, which contain the principal fleshy part of the body, and which, in fact, we all know particularly well, because they form the portion that we ourselves use as food, and they have a cylindrical head and chest (so to say), as well as a considerable number of swimming appendages. But if you compare a lobster with a crab you will find that, while they agree with one another in many important points of structure far more closely than they do with their lower relations, they yet differ in general outward appearance far more widely than the prawn and shrimp. It is these conspicuous outward differences—merely adaptive points to the true biologist—that most require explanation in the eyes of the world at large. The other matters are the really important ones—the ones on which the science of biology must be fundamentally based; but these are the ones that interest ordinary people the most.

Now, the adaptive differences between crabs and lobsters are all due to the initial fact that the crab is a walking crustacean, while the lobster is a jumping and swimming one. If you watch the lobsters in an aquarium, you will see that they hardly use their small legs for walking at all; they employ them almost entirely for standing, or rather for poising themselves lightly upon the shelves of rock where they love to loiter. There are two large muscular tracts in the lobster's body—the two parts which we mainly use for food; one is the big and powerful tail, which is the real organ of locomotion in the lobster; the other is the two great claws, which, of course, are used as organs of prehension and weapons of offence or defence. But if you look closely at a crab, you will find that though its members answer in the main, part for part, to the members of the lobster, its shape and relative development are very different. The tail, instead of being a large fleshy organ, capable of producing long and rapid springs through the water, is doubled up and tucked away under the crab's body; and, as we have frequently had occasion to observe when eating crab (the only form of dissection that most of us ever practise), it contains no meat worth the trouble of extracting. The fact is, most crabs have so long found their tails a mere incumbrance, and have consequently tucked them quietly away behind them, that they have gradually dwindled by disuse, in accordance with a well-known general law, that all parts which are seldom or never exercised tend slowly to atrophy and obsolescence. Use and disuse combine with natural selection thus to alter the forms of organs. A part which is much exercised tends to grow large and prominent; a part which is little exercised tends to fade imperceptibly away.

The other clause of this law is equally well exemplified in the body and legs of the crab. What most people naturally regard as the whole creature (barring the small and inconspicuous tail) answers in fact merely to the front half or "body" of the lobster; and as this part contains

the only organs of locomotion now practically used by the adult crab—namely, the legs—it has grown to a relatively immense and inordinate size. In a crab, we have all observed (also in pursuit of our personal objects) the meatiest part after the big grasping claws consists of the network of shell and muscles in the under portion of the body. Now, this part is really the governing and moving mechanism of the small legs, or, in other words, the muscles that actually do the work of walking. Hence it is easy to see why the crab differs so much in externals from the lobster. But, besides this main central difference, there are other minor differences of shape and appearance, due in like manner to adaptive modification. While the lobster's whole form is roughly cylindrical and pointed in front, so as to enable him to dart readily through the water with very little resistance, the crab's form is much more flattened and massive, so as to suit better with his crawling and almost terrestrial habits, as he makes his way quietly and unobtrusively along the bottom. The one type might almost be compared with that of the greyhound or the hare, the other with that of the tortoise or the armadillo. Indeed, the crabs are by far the most land-loving of all their immediate group, for most of them hug the shore, many of them live on the margin between high and low water, and not a few of them have actually taken to living on dry land, or even climbing considerable mountains. These last return annually to the sea in order to lay their eggs, and the young pass their early or larval stages as free swimming creatures in the salt water, but in their full-grown form they take at length to the land, and there grub away in the soil to their heart's content. Grubbing, in fact, even more than walking, might be set down as the peculiar differentia of the crab race, the one thing which, more than any other, has given the whole group its special and distinctive features. To my mind there is no more speaking lesson in evolution than just to buy a common edible crab, and look at the curiously dwarfed and dwindled condition of its tail. If that one simple concrete argument and example does not convert a man, he must be hard wedded indeed to his own view of the cosmos and its origin.

HOW TO GET STRONG.

REDUCING FAT.

IT is hard to say whether corpulence is to be regarded as a greater nuisance in its direct or in its indirect effects—whether it is worse to be loaded constantly with the weight of two or three suits of clothes, to have the circulation impeded, the liver obstructed, and the lungs oppressed, or to be rendered almost unable, and quite unwilling, to take such exercise as would open the lungs, free the liver, and stimulate the circulation. The mischief of corpulence works in a very vicious circle. It is an evil in itself, and it tends to increase its own evil effects.

At the very outset, then, of any system of exercise for those who are oppressed with much fat, comes the inquiry, how that excess of adipose tissue is to be reduced. Observe, I say "fat," not "flesh." It is absurd to speak of fat men as fleshy men. No one is the worse for flesh, nor can there well be excess of it; for flesh is muscle. It is excess of fat only which is obnoxious; and because, amongst other reasons, wherever there is excess of fat there is defect or deterioration of flesh.

Now, with regard to the reduction of fat, there are a dozen or so of methods which are in more or less favour with those whom Dr. Dio Lewis calls the "wobblers," though in England, at any rate, many fat men walk as steadily, in appearance, as the lean ones. I do not, for my own part, believe in any one of these methods; but I believe in all or very nearly all of them. This sounds like a contradiction; but it is not. I think the fat man who pins his faith on this, that, or the other cure for obesity, is not only unlikely to get rid of his extra fat, but is very likely to do himself serious mischief. But I think also that the man who pins his faith on this, that, *and* the other cure, is very likely, if he is patient and resolute, to be successful in reducing himself to reasonable proportions. It is by applying all the proper remedies (for some are obviously bad) at the same time, and in due proportion, that fat may be reduced most safely and most effectively.

But in the struggle with obesity, resolution, self-restraint, and patience are all important. Unfortunately, fat is very often an evidence of impatience, weak will, and want of self-restraint. Also of want of wisdom. The pleasure of a goodly meal, swallowed hastily (that is, without due patience in mastication), washed down (hateful, but in such cases too appropriate expression) by draughts of wine, or beer, or spirits, and followed by fat-engendering repose, seems greater than the enduring pleasure of good digestion, active frame, and light spirits, with the power to limit sleep to sleep's proper hours. A quiet read in a soft arm-chair by the fire-side in winter, or in the cool, softly-lit study in summer, seems a greater good, even when taken at the expense of exercise which the body needs, than the less-noticed, but longer lasting, sweetness of health and cheerfulness secured by a wholesome regimen.

The necessary resolution, patience, and self-restraint to reduce excess of fat can be obtained in no other way that I know of than by reasoning. Let a man consider within himself what he pays for those indulgences which keep him fat, and he must be foolish, I take it, if he is unwilling to give them up or to reduce them in such degree as may be necessary. Nay, let him even consider the matter in the light of such indulgences. Does he enjoy his food as much when over-burdened with fat as he would if he were in better condition? Does he enjoy the rest he takes unnecessarily anything like the rest he would *want* if he were more active? In fact, does he know the real pleasure afforded by either feeding or resting? One meal sauced by hunger is worth a dozen eaten when the system is already over-loaded. One rest earned by exercise is worth any amount of lounging laziness. Then again, consider the work a fat man has to do as a direct result of shirking work he ought to do. The man who has been unwilling to walk four or five miles a day when of reasonable weight, has no choice later (unless he summons resolution and patience to his aid) but to carry about with him wherever he goes a load of perhaps forty or fifty pounds of useless muscle-encumbering fat. A man who is unwilling to put on a suit of flannels and a "sweater," weighing, perhaps, two or three pounds more than his usual dress, to work off a pound or two of his weight, carries about with him (groaningly, it may be, but still unresistingly) the weight of five or six complete suits of clothing.* A man who is unwilling to sweat for his health, sweats daily four or five times as much as leaner men, though what he so loses he replaces by heavy draughts, not always of innocuous water.

So much premised, and noting also that to follow at once several fat-reducing methods is much easier, as it will be found much more effective and therefore much more encouraging than to follow one, I proceed to consider

* A summer suit of clothes for a man of medium size (height and stoutness) weighs about 8 lb., including boots and hat. A fat man not only carries 40 lb. or 50 lb. more weight of his own than he need, but has to have rather heavier clothing.

the various methods available for attacking superabundant fat, hoping that many overweighted persons among my readers may take courage to enter systematically and patiently on the profitable work of fat-reduction.

I begin with medicinal systems as on the whole the least useful methods, and those which need to be most cautiously applied, where applied at all. (I say nothing of corset or busk wearing, partly because in a former paper I said enough of that foolish plan, only fit for those whose resolutions needs bolstering up artificially. I note only in passing that our editor must have been of most inquiring disposition to put so obviously unnatural a method to the test.)

Nearly all medical methods for the reduction of at depend in reality on the amount of mischief which may be done by medicines to the digestive system and to the appetite. If a man takes an emetic four or five times a day, and a strong aperient twice or thrice a day, he would, probably, be considerably reduced at the end of two or three weeks, supposing he survived. It is easy to devise medical systems which, without being quite so obviously pernicious, would do so much mischief that a man's weight would soon be much reduced, and also his strength. Of such systems nothing good can be said. Akin to them are such methods as depend on dosing the food with vinegar, or otherwise making it either unpalatable or unprofitable. Yet medicines may be used, especially at the beginning of a course of fat-reduction, with some advantage, if wisely administered—which should be done by medical advice. The fat man is in an unwholesome state, and though he may be able to get better without medicine, he may save some trouble by taking such medicines as a sensible doctor may consider suitable to help the action of the stomach, the liver, the kidneys, and the skin. Albeit, recourse should only be had, in my opinion, to the doctor, in very bad cases, or where, as sometimes happens, the first application of other and better methods leads to constipation, chills, headaches, and other forms of mischief. These are so apt to dishearten the struggler against fat, that it may often be well to give the disordered, impeded, or congested organs a little help from judiciously-selected drugs.

(To be continued.)

THE CHEMISTRY OF COOKERY.

XIV.

By W. MATTIEU WILLIAMS.

IN my last I described the dissociation of sugar by hea and the formation of caramel, to illustrate by simple example the "browning" of other kinds of food. I might have added, in connection with this cookery of sugar, an historical connection with one of the lost arts of the kitchen—viz., the "spinning" of sugar. Within the reach of my own recollection no evening party could pretend to be stylish unless the supper-table was decorated with a specimen of this art—a temple, a pagoda, or something of the sort done in barley-sugar. These were made by raising the sugar to 320°, when it fused and became amorphous, or vitreous, as already described. The cook then dipped a skewer into it, the melted vitreous sugar adhered to this and was drawn out as a thread, which speedily solidified by cooling. While in the act of solidification it was woven into the desired form, and the skilful artist did this with wonderful rapidity. I once witnessed with childish delight the spinning of a great work of art by a French cook in St. James's Palace. It was a ship in full sail, the sails of edible wafer, the hull a basket work of spun sugar, the masts of massive sugar-sticks, and the rigging of delicate threads of the same. As nearly as I can remember, the whole was completed in about an hour.

But to return from high art to chemical science. The conversion of sugar into caramel is, as already stated, attended with a change of flavour; a kind of bitterness replaces the sweetness. This peculiar flavour, judiciously used, is a powerful adjunct to cookery, and one which is shamefully neglected in our ordinary English domestic kitchens. To test this, go to one of those Swiss restaurants originally instituted in this country by that enterprising Ticinese, the late Carlo Gatti, and which are now so numerous in London and our other large towns; call for *maccaroni al sugo;* notice the rich, brown gravy, the "sugo." Many an English cook would use half-a-pound of gravy beef to produce the like, but the basis of this is half-an-ounce of sugar, or even less; the sugar is browned by heating, not quite up to the caramel state. Burnt onion may contribute, but this is only another form of caramel with more savoury properties.

While engaged upon your maccaroni, look around at the other dishes served to other customers. Instead of the pale slices of meat spread out in a little puddle of pale, watery liquid, that are served in English restaurants of corresponding class, you will see dainty morsels, covered with rich, brown gravy, or surrounded by vegetables immersed in the same. This sugo is greatly varied according to the requirements, by additions of stock-broth, tarragon vinegar, ketchup, &c., &c., but burnt sugar, or burnt onions, or burnt something is the basis of it all, sugar being the cheapest.

To further test the flavouring properties of browning, take some eels cut up as usual for stewing; divide into two portions; stew one brutally—by this I mean simply in a little water—serving them with this water as a pale gravy or juice. Let the second portion be well fried, fully browned, then stewed, and served with brown gravy. Compare the result. Make a corresponding experiment with a beef-steak. Cut it in two portions; stew one brutally in plain water; fry the other, then stew it and serve brown.

Take a highly-baked loaf, better one that is black outside; scrape off the film of crust that is quite black, *i.e.*, completely carbonised, and you will come to a rich brown layer, especially if you operate upon the bottom crust. Slice off a thin shaving of this, and eat it critically. Mark its high flavour as compared with the comparatively insipid crumb of the same loaf, and note especially the resemblance between this flavour and that of the caramel from sugar, and that of the browned eels and browned steak. A delicate way of detecting the flavour due to the browning of bread is to make two bowls of bread and milk in the same manner, one with the crust, the other with the crumb of the same loaf. I am not suggesting these as examples of better or worse flavour, but as evidence of the fact that much flavour of some sort is generated. It may be out of place, as I think it is, in the bread and milk, or it may be added with much advantage to other things, as it is by the cook who manipulates caramel and its analogues skilfully.

The largest constituent of bread is starch. Excluding water, it constitutes about three-fourths of the weight of good wheaten flour. Starch differs but little from sugar in composition. It is easily converted into sugar by simply heating it with a little sulphuric acid, and by other means of which I shall have to speak more fully hereafter when I come to the cookery of vegetables. When simply heated, it is converted into dextrin or "British gum,"

largely used as a substitute for gum arabic. If the heat is continued a change of colour takes place; it grows darker and darker until it blackens just as sugar does, the final result being nearly the same. Water is driven off in both cases, but in carbonising sugar we start with more water, sugar being starch plus water or the elements of water. Thus the brown material of bread-crust or toast is nearly identical with caramel.

I have often amused myself by watching what occurs when toast and water is prepared, and I recommend my readers to repeat the observation. Toast a small piece of bread to blackness, and then float it on water in a glass vessel. Leave the water at rest, and direct your attention to the under side of the floating toast. Little thread-like streams of brown liquid will be seen descending in the water. This is a solution of the substance which, if I mistake not, is a sort of caramel, and which ultimately tinges all the water.

Some years ago I commenced a course of experiments with this substance, but did not complete them. In case I should never do so, I will here communicate the results attained. I found that this starch caramel is a disinfectant, and that sugar caramel also has some disinfecting properties. I am not prepared to say that it is powerful enough to disinfect sewage, though at the time I had a narrow escape from the Great Seal Office, where I thought of patenting it for this purpose as a non-poisonous disinfectant that may be poured into rivers in any quantity without danger. Though it may not be powerful enough for this, it has an appreciable effect on water slightly tainted with decomposing organic matter.

This is a very curious fact. We do not know who invented toast and water, nor, so far as I can learn, has any theory of its use been expounded, yet there is extant a vague popular impression that the toast has some sort of wholesome effect on the water. I suspect that this must have been originally based on experience, probably on the experience of our forefathers or foremothers living in country places where stagnant water was a common beverage, and various devices were adopted to render it potable.

Gelatine, fibrine, albumen, &c.—*i.e.*, all the materials of animal food—as already shown, are composed, like starch and sugar, of carbon, hydrogen, and oxygen, with, in the case of these animal substances, the addition of nitrogen; but this does not prevent their partial carbonisation (or "caramelising," if I may invent a name to express the action which stops short of blackening). Animal fat is a hydro-carbon which may be similarly browned, and, if I am right in my generalisation of all these browning processes, an important practical conclusion follows, viz., that cheap soluble caramel made by skilfully heating common sugar is really, as well as apparently, as valuable an element in gravies, &c., as the far more expensive colouring matter of brown meat gravies, and that our English cooks should use it far more liberally than they usually do.

Its preparation is easy enough; the sugar should be gradually heated till it assumes a rich brown colour and has lost its original sweetness. If carried just far enough, and not too far, the result is easily soluble in hot water, and the solution may be kept for a long time, as it is by cooks who understand its merits. In connection with the idea of its disinfecting action, I may refer to the cookery of tainted meat or "high" game. A hare that is repulsively advanced when raw, may by much roasting and browning become quite wholesome, and such is commonly the case in the ordinary cooking of hares. If it were boiled or merely stewed (without preliminary browning) in this condition, it would be quite disgusting to ordinary palates.

A leg of mutton for roasting should be hung until it begins to become odorous; for boiling it should be as fresh as possible. This should be especially remembered now that we have so much frozen meat imported from the antipodes. When duly thawed it is in splendid condition for roasting, but is not usually so satisfactory when boiled. I may here mention incidentally that such meat is sometimes unjustly condemned on account of its displaying a raw centre when cooked. This arises from imperfect thawing. The heat required to thaw a given weight of ice and bring it up to 60°, is about the same as demanded for the cookery of an equal quantity of meat, and therefore, while the thawed portion of the meat is being cooked, the frozen portion is but just thawed, and remains quite raw.

A much longer time is demanded for thawing—*i.e.*, supplying 142° of latent heat—than might be supposed. To ascertain whether the thawing is completed, drive an iron skewer through the thickest part of the joint. If there is a core of ice within it will be distinctly felt by its resistance.

THE MORALITY OF HAPPINESS.

By Thomas Foster.

INTRODUCTORY.

IT is known to all who watch the signs of the times—obvious, indeed, to them, and known to many who are less observant—that those moral restraints which claim to be of sacred origin are no longer accepted by a large and increasing number of persons. I have no wish to inquire here whether those restraints should be regarded as of divine origin or not. I note only the fact that by many they are not so regarded. I am not concerned to ask whether it is well or ill that their authority should be rejected, and their controlling influence be diminishing or disappearing among many; it suffices, so far as my present purpose is concerned, that the fact is so. The question then presents itself, Does any rule of conduct promise to have power now or soon among those who have rejected the regulative system formerly prevalent? We need not consider whether such a rule of conduct, necessarily secular in origin, is in itself better or worse than a rule based on commandments regarded as divine. All we have at present to ask is whether such a regulative system is likely to replace the older one with those over whom that older law no longer has influence.

Here at the outset we find that those who hold extreme views on either side of the questions I have left untouched, agree in one view which is, I think, erroneous. On the one hand, those who maintain the Divine character of the current creed insist, not only that it is sufficient for all, but that, in the nature of things, no other guide is possible. On the other hand, those who reject the authority of that creed most energetically, assert as positively that no new regulative system, no new controlling agency, is necessary. As Mr. Herbert Spencer has well put it, "both contemplate a vacuum, which one wishes and the other fears." But those who take wiser and more moderate views, who, in the first place, recognise facts as they are, and, in the next, are ready to subordinate their own ideas of what is necessary or best for the ideal man to the necessities of man as he really is, perceive that for the many who no longer value a regulative system which, so far as they are concerned, is decaying, if not dead, another regulative system is essential. Again to use the words of the great philosopher whose teachings are to be our chief guide in this series of papers, "Few things can happen more

disastrous than the decay and death of a regulative system no longer fit" (for those we are considering), "before another and fitter regulative system has grown up to replace it."

My purpose in these papers is to show how rules of conduct may be established on a scientific basis for those who regard the so-called religious basis as unsound.* I shall follow chiefly the teachings of one who has inculcated in their best and purest form the scientific doctrines of morality, and may be regarded as head, if not founder, of that school of philosophy which, on purely scientific grounds, sets HAPPINESS as the test of duty—the measure of moral obligation. To Mr. Herbert Spencer we owe, I take it, the fullest and clearest answer to the melancholy question, Is Life Worth Living? whether asked whiningly, as in the feeble lamentations of such folk as Mr. Mallock, or gloomily and sternly, as in the Promethean groans of Carlyle. The doctrine that happiness is to be sought for oneself (but as a duty to others as well as to self), that the happiness of others is to be sought as a duty (to oneself as well as to them)—happiness as a means, happiness as the chief end—such has been the outcome of the much-maligned philosophy of Mr. Herbert Spencer, such has been the lesson resulting from his pursuance of what he himself describes as his "ultimate purpose, lying behind all proximate purposes," that of "finding for the principles of right and wrong in conduct at large, a scientific basis."

If I can help to bring this noble and beautiful doctrine—for noble and beautiful even those must admit it to be who deny its truth—before the many who regard Herbert Spencer's teachings with fear and trembling, not knowing what they are, I shall be content. But I would advise all who have time to read the words of the master himself. Apart from the great doctrines which they convey, they are delightful reading, clear and simple in language, graceful and dignified in tone, almost as worthy to be studied as examples of force and clearness in exposition as for that which nevertheless constitutes their real value—the pure and beautiful moral doctrines which they offer to those over whom current creeds have lost their influence.

Let me hope that none will be deterred from following this study, by the inviting aspect of the moral rules advanced by the great modern teacher—even as in past times men were anxious, or even angry, when another teacher showed more consideration for human weaknesses than had seemed right to the men of older times. I will not ask here whether doctrines of repellant aspect are likely to be more desirable than those which are more benignantly advanced. It suffices that with many the former now exert no influence, whether they should do so or not. So that, as far as these (for whom I am chiefly writing) are concerned, all must admit the truth of what Mr. Spencer says respecting the benefits to be derived from presenting moral rule under that attractive aspect which it has when undisturbed by superstition and asceticism. To close these introductory remarks by a quotation from the charming pages of his "Data of Ethics":—

"If a father, sternly enforcing numerous commands, some needful and some needless, adds to his severe control a behaviour wholly unsympathetic—if his children have to take their pleasures by stealth, or, when timidly looking up from their play, ever meet a cold glance, or more frequently a frown, his government will inevitably be disliked, if not hated; and the aim will be to evade it as much as possible. Contrariwise, a father who, equally firm in maintaining restraints needful for the well-being of his children or the well-being of other persons, not only avoids needless restraints, but, giving his sanction to all legitimate gratifications, and providing the means for them, looks on at their gambols with an approving smile, can scarcely fail to gain an influence which, no less efficient for the time being, will also be permanently efficient. The controls of such two fathers, symbolise the controls of morality as it is and morality as it should be."

(To be continued.)

* I say "so-called," referring rather to the *word* "religious" than to any question concerning the divine origin of current creeds. Strictly speaking, the word religious may be as correctly applied to moral rules based on scientific considerations, as to those formulated in company with any of the diverse creeds prevailing among men.

THE BIRTH AND GROWTH OF MYTH.

By EDWARD CLODD.

XI.

THE belief that human beings could change themselves into animals was alluded to in my remarks on witchcraft, but, in view of its large place in the history of illusions, too incidentally, and it is proposed to give it further reference here.

Superstitions which now excite a smile, or which seem beneath notice, were no sudden phenomena, appearing now and again at the beck and call of wilful deceivers of their kind. That they survive at all, like organisms, atrophied or degenerate, which have seen "better days," is evidence of remote antiquity and persistence. Every seeming vagary of the mind had serious importance, and answered to some real need of man as a sober attempt to read the riddle of the earth and get to its inmost secret.

So with this belief. It is the outcome of that early thought of man which conceived a common nature and fellowship between himself and brutes, a conception based on rude analogies between his own and other forms of life, as also between himself and things without life, but having motion, be they waterspouts or rivers, trees or clouds, especially these last, when the wind, in violent surging and with howling voice, drove them across the sky. Where he blindly, timidly groped, we walk as in the light, and with love that casts out fear. Where rough resemblances suggested to him like mental states and actions in man and brute, the science of our time has, under the comparative method, converted the guess into a certainty; not to the confirmation of his conclusions, but to the proof of identity of structure and function, to the demonstrating of a common origin, however now impassable the chasm that separates us from the lower animals.

The belief in man's power to change his form and nature is obviously nearly connected with the widespread doctrine of metempsychosis, or the passing of the soul at death into one or a series of animals, generally types of the dead man's character, as where the timid enter the body of a hare, the gluttonous that of a swine or vulture.

> "Fills with fresh energy another form,
> And towers an elephant or glides a worm;
> Swims as an eagle in the eye of noon,
> Or wails a screech-owl to the deaf, cold moon,
> Or haunts the brakes where serpents hiss and glare,
> Or hums, a glittering insect, in the air."

But while in transmigration the soul returns not to the body which it had left, transformation was only for a time, occurring at stated periods, and effected by the will of the transformed, or by the aid of sorcery and magic, or

sometimes imposed by the gods as a punishment for impious defiance and sin.

Other causes, less remote, aided the spread of a belief to which the mind was already inclined. Among these were the hallucinations of men who believed themselves changed into beasts, and who, retreating to caves and forests, issued thence howling and foaming, ravening for blood and slaughter; hallucinations which afflicted not only single persons, as in the case of Nebuchadnezzar, whose milder monomania (he, himself, saying in the famous prize poem:—

"As he ate the unaccustomed food,
It may be wholesome, but it is not good,")

rather resembled that of the daughters of Prætus, who believed themselves cows, but which also spread as virulent epidemic among whole classes. It is related that, in 1600, multitudes were attacked by the disease known as lycanthropy, or wolf-madness (from Greek, *lukos*, a wolf, and *anthropos*, a man), and that they herded and hunted in packs, destroying and eating children, and keeping in their mountain fastnesses a cannibal or devil's sabbath, like the nocturnal meetings of witches and demons known as the Witches' Sabbath. Hundreds of them were executed on their own confession, but some time elapsed before the frightful epidemic, and the panic which it caused, passed away. Besides such delusions, history down to our own time records instances where a morbid, innate craving for blood, leading sometimes to cannibalism, has shown itself. Mr. Baring-Gould, in his "Book of Werevolves," cites a case from Gall of a Dutch priest who had such a desire to kill and to see killed that he became chaplain to a regiment for the sake of witnessing the slaughter in battle. But still more ghastly are the notorious cases of Elizabeth, an Hungarian lady of title, who inveigled girls into her castle and murdered them that she might bathe her body in human blood to enhance her beauty; and of the Maréchal de Retz who, cursed with the abnormal desire to murder children, allured them with promises of dainties into his kitchen, and killed them, inhaling the odour of their blood with delight, and then burned their bodies in the huge fireplace in the one room devoted to these horrors. When the deed was done, the Maréchal would lie prostrate with grief, "would toss weeping and praying on a bed, or recite fervent prayers and litanies on his knees, only to rise with irresistible craving to repeat the crime."

Such instances as the foregoing, whether of delusion or morbid desire to destroy, are among secondary causes; they may contribute, but they do not create, being inadequate to account for the world-wide existence of transformation myths. The animals which are the supposed subject of these vary with the habitat, but are always those which have inspired most dread from their ferocity. In Abyssinia we find the man-hyæna; in South Africa, the man-lion; in India, the man-tiger; in Northern Europe, the man-bear; and in other parts of Europe the man-wolf, or were-wolf (from A.-S. *wer*, a man).

Among the many survivals of primitive thought in the Greek mythology, which are the only key to its coarser features, this of belief in transformation occurs, and, indeed, along the whole line of human development it appears and re-appears in forms more or less vivid and tragic. The gods of the South, as of the North, came down in the likeness of beasts and birds, as well as of men, and among the references to these myths in classic writers, Ovid, in the "Metamorphoses," tells the story of Zeus visiting Lykaon, king of Arcadia, who placed a dish of human flesh before the god to test thereby his omnisicence. Zeus detected the trick, and punished the king by changing him into a wolf, so that his desire might be towards the food which he had impiously offered to his god.

"In vain he attempted to speak; from that very instant
His jaws were bespluttered with foam, and only he thirsted
For blood, as he raged amongst flocks and panted for slaughter.
His vesture was changed into hair, his limbs became crooked.
A wolf—he retains yet large traces of his ancient expression,
Hoary he is as afore, his countenance rabid,
His eyes glitter savagely still, the picture of fury."

But we may pass from this and such-like tales of the ancients to the grim realities of the belief in mediæval times.

LAWS OF BRIGHTNESS.

VI.

By Richard A. Proctor.

ZÖLLNER, as I have said, regards the full moon as though she were a nearly flat disc under full solar illumination. He estimates the brightness of the full moon at $\frac{1}{619{,}600}$ of the sun's, and, comparing surfaces, he makes the sun's brightness equal to 618,000 times the moon's. Now, it is easy to determine what would be the brightness of the full moon supposing the surface perfectly reflective (not specularly) and smooth, and regarding it as a flat disc. Such a disc, placed where the moon is, would be illuminated by a sun about 32′ in diameter, since the sun appears as large seen from the moon as seen from the earth. Now, such a sun would occupy a part of the whole heavenly sphere represented by the proportion $\frac{\text{vers} \cdot 16'}{2 \cdot \text{rad}}$ or 0·0000054. But the brightness of such a disc, supposed to be illuminated by both halves of a complete enclosing sphere of solar brightness, would be the same as the sun's brightness. Now, different parts of such enclosing sphere would illuminate the disc at different angles, and, therefore, we must not consider the mere area of the sphere. Thus, the portion P, Fig. 13, of such a sphere (the radius may be any whatever) would illuminate D obliquely, and with an effect reduced from

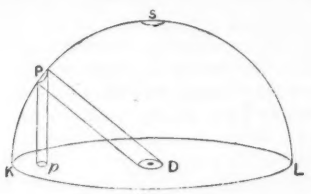


Fig. 13.

what would result if the illumination were direct, in the proportion of the sine of arc P K to unity. But it is obvious that the little area p, which is the orthogonal projection of P on K L (the plane of D), bears just this proportion to P. Hence the illuminating effect of the area P may be represented by the area p, and the total illuminating effect of the hemisphere will be represented by the area of the circle K L. Thus, for the whole sphere, we get twice the area K L, instead of the area of the sphere (which is four times this circle). Thus, the actual illumination of the supposed disc placed where the full moon is, bears to solar brightness the ratio of area S (representing

the space on the heavens occupied by the sun, supposed vertical) to half the area of the whole sphere, or the ratio

108 : 10,000,000

or 1 : 92,592.

If we suppose the disc replaced by a smooth spherical moon, we must increase 92,592 in the ratio of 3 to 2, getting the ratio

1 : 138,888.

Now, the actual quantity of light received from the moon is about 1,618,000th of the sun's light, or less than the 92,592nd part in the ratio

92,592 to 618,000,

which would give the moon's reflective power (on the assumption of her reflecting as a flat disc, and of her disc being as large as the sun's), the value

$$\frac{92,592}{618,000};$$

but taking into account the smaller mean disc of the moon, we deduce the value 0·16 approximately. Taking the moon as a smooth sphere, we obtain the value 0·24. Now, Zöllner gives the value 0·1736, which is much nearer the former than the latter value. This is what, following Lambert, he calls the *albedo*, or whiteness of the moon; and he justly remarks that, taking her whole brightness, the moon must be regarded as more nearly black than white. But he adds that from his estimates of the illumination of the moon's brighter or brightest parts, he is satisfied that their whiteness can be compared with that of the whitest of terrestrial substances—or, to use his own words, he has arrived at the result "dass der Mond an seinen *helleren* und *hellsten* stellen aus einem Stoffe besteht, der, auf die Erde gebracht, zu den weissesten der uns bekannten Körper gezählt werden würd."

Zöllner gives the following determination of the *albedines* or *whitenesses* of different terrestrial substances :—

By diffused reflected light—	
Snow just fallen	0·783
White paper	0·700
White sandstone	0·237
Clay marl	0·156
Quartz porphyry	0·108
Moist soil	0·079
Dark gray syenite	0·078
By regular reflection—	
Mercury	0·648
Speculum metal	0·535
Glass	0·040
Obsidian	0·032
Water	0·021

It will be noticed how closely Zöllner's result accords with the statement of Sir John Herschel that the moon's average brightness does not exceed that of sandstone. "The actual illumination of the lunar surface is not much superior," Herschel says, "to that of weathered sandstone rock in full sunshine. I have frequently compared the moon setting behind the grey perpendicular façade of the Table Mountain, illuminated by the sun just risen in the opposite quarter of the horizon, when it has been scarcely distinguishable in brightness from the rock in contact with it. The sun and moon being nearly at equal altitudes, and the atmosphere perfectly free from cloud or vapour, its effect is alike on both luminaries."

It follows, of course, that since the brightest portions of the moon's surface are four or five times as bright as her average or mean illumination, the darkest portions are very much less bright than the average. We may assume that the floor of Plato, for instance (not absolutely the darkest part of the moon), is considerably darker even than dark grey syenite.

(To be continued.)

ARE COPPER SALTS POISONOUS?

TO most readers this will seem a foolish question, as from one generation to another people have been warned against pickles made green with copper salts, putting halfpence into the pot with peas or cabbages to ensure their coming to table with good complexions, and against cooking anything in copper vessels without special precautions to prevent the metal from being acted upon. It is hard to believe that all these warnings have been unnecessary, that so far from copper salts being mischievous, they can do no harm in the quantities likely to be found in food in consequence of the practices mentioned, and may even be of prophylactic use to the persons swallowing them. About a year ago a number of French doctors took copper-tinted peas and similar articles under their protection, and at the same time advocated the greatest care in keeping lead salts out of the way. They considered it very dangerous for tinned vessels intended to hold preserved meats or vegetables to be soldered inside, as the lead of the solder was likely to be acted upon, and even in very small quantities the lead salts would be dangerous. Copper salts are distinguished from lead salts in having no cumulative action upon the system, and symptoms of poisoning do not follow their repetition in minute doses, as they do in the case of lead. As a practical question, it is contended that the employment of copper as a food colouring agent ought not to be treated as an adulteration dangerous to health, and a decision in Belgium has been lately reported founded upon this view.

M. A. Gautier has recently published a work on "Copper and Lead in Alimentation and Industry," and his statements regarding the former metal coincide with those of previous French inquirers. He speaks of the presence of copper as a normal ingredient in many articles of food, such as wheat, barley, rice, beans, coffee, &c. The quantities in these cases are infinitesimal, but capable, in some instances, of producing a noticeable effect upon the creature swallowing them, as in the interesting case of the Turacous, whose fine red feathers Professor Church discovered to be coloured with a compound he named *turacine*, which was soluble in soft water, and contained a portion of copper derived from the fruits on which the birds feed.

M. Gautier finds in the articles of food above mentioned from four to ten milligrammes per kilogramme* of copper. Preserved aliments, such as vegetables and fruits, with copper "verdure clad," contain more of that metal—from ten to 200 milligrammes per kilogramme. Five milligrammes a day he reckons to be about the quantity commonly taken, and no inconvenience results from it. Chocolate is amongst the articles which, contrary to what might be expected, appear to contain a maximum of copper. The strong and repulsive flavour of copper-salts limits the quantity anybody would be willing to swallow. When food is dosed with four grammes (over 61 grains) per kilogramme, it is too nasty to eat; but even then M. Gautier affirms it would not be dangerous to take. Copper salts soon act as an emetic, unless the quantity is small, and, according to the new views, poisoning by them is almost impossible. These opinions are founded upon experiments French doctors have made upon themselves and their friends. Dr. Galippe as far back as 1875 tried copper salts upon various animals, and acquired so much confidence in their innocence that he proceeded to take and give verdigris to his family and acquaintances without any mischief ensuing.

* The milligramme is ·0154 of a grain; the kilogramme 2 lb. 3 oz. 5 drams, or 154440·2344 grains.

XUM

According to these notions tinning copper vessels is not only unnecessary, but is a source of danger, as it is common to mix lead with the tin, partly because it is a much cheaper metal, and perhaps, still more, because it facilitates the process. Many of the disasters attributed to copper are now thought more likely to have been caused by the tinning. An unclean copper vessel is pronounced less dangerous than that one tinned with an alloy containing 10 per cent. of lead, and from 30 to 40 per cent. is found to be a common proportion. The chances of lead getting into the system are very great. The mischievous metal lurks in sardines, tunny, and lobster, as well as in the vegetables sold in tins. It is also to be found in shining wall-papers, certain table-cloths, the glazing of earthenware, and in a swarm of cosmetics.

In India, it is customary for Europeans to have all their cooking done in copper vessels, which are retinned every few weeks. In the army some precautions are taken to prevent the employment of a lead alloy in this process, but ordinary poisons are easily checked. When some of the so-called tinning is worn off the copper, the lead is more likely to be acted upon, and it is not improbable that some supposed copper poisonings have been effected by the lead. We should be glad if our medical readers in India would look into this question, and let us know the result.

Small doses of copper salts are supposed to exert a preservative action against typhoid fevers and some other complaints. Workers in copper and players upon copper and brass instruments are said to have escaped from typhoid poisoning better than other folks. Compared with the whole population, they are a very small class; there may be other things besides their contact with a particular metal that may help to secure their immunity. The question demands further inquiry.

THE FISHERIES EXHIBITION.

By JOHN ERNEST ADY.

III.

IN that most delightful seaside resort in the Isle of Wight called Freshwater there is a bay adjoining the little hotel village known as Scratchell's Bay. The escarpment of the chalk cliffs, which descends abruptly for several feet to the level of the sea, shows in a most remarkable manner layer after layer of chalk, alternating with linear bands of flints. We have already solved the problem of the origin of the chalk with the assistance of the microscope, but how about the flint? It has been supposed that the flint derived its existence from the tests of *siliceous* organisms which abounded in the Cretaceous seas, and which have been dissolved and redeposited in that new and obscure shape. We pointed out before* that the tests of *Foraminifera* undergo profound changes at great depths, which result in the formation of a fine "red clay" (a silicate of iron and alumina) almost free from any traces of organised remains. We may now draw attention to the fact that in certain localities, *e.g.* the Gulf of Mexico, in comparatively shallow water (100 to 300 fathoms), the calcareous shells of the *Foraminifera* are subject to other changes, whereby the chambers of their tests become filled with a green material (also a silicate of iron and alumina), whilst the calcareous walls gradually disintegrate and finally dissolve, leaving behind the so-called "green sand" composed of a mass of exquisite casts or pseudomorphs of the shell chambers; these finally break down and crumble away into a formless paste, the vestiges of former animation. Evidences of the organic origin of vast azoic formations have thus been elucidated by the recent researches of the deep sea explorations, and suggested to the mind of the late Sir Wyville Thomson that many of the most ancient (Cambrian and pre-Cambrian) rocks, such as the highly-metamorphosed slates, &c., may possibly have been derived from foraminiferal and other remains. Whilst noting these phenomena, Huxley* observes that the words of Linnæus may be literally true when he says:—

"Petrefacta non a calce, sed calx a petrefactis. Sic lapides ab animalibus, nec vice versâ. Sic rupes saxei non primævi, sed temporis filiæ."

And he adds:—

"And there may be no part of the common rocks, which enter into the earth's crust, which has not passed through a living organism at one time or another."

But apart from the silent flints and clays, there are large zones of the crust of the earth which testify aloud to the former existence of myriads of lovely organisms which resemble the *Foraminifera* in many things, but are possessed of siliceous instead of calcareous tests. These *Radiolaria* form great masses of rock in the Barbadoes. Fig. 6 is a

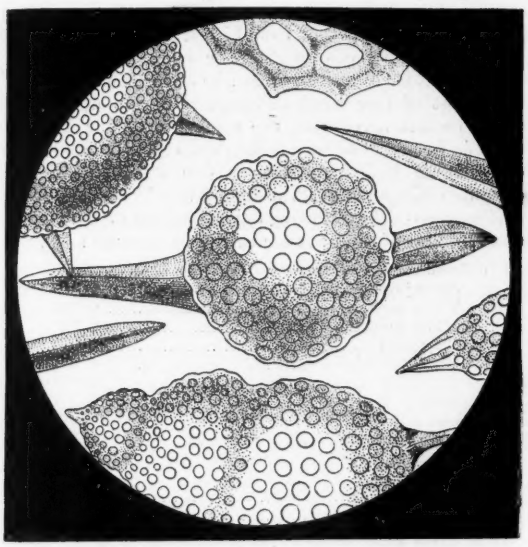


Fig. 6.—POLYCYSTINA, "Barbadoes earth." Tertiary deposits, Springfield, Barbadoes. × 300 diameters. (*Original.*)

drawing, magnified 300 diameters, of some of these beautiful skeletons. They are called *Polycystina*, and may be readily obtained for examination by the following method:—

Procure a small piece of the friable rock known as "Barbadoes earth," put it into a large test-tube, and add equivalent bulks, each of water and washing soda; boil for about one hour. The upper pellicle must now be poured off, fresh water and washing soda added, and the boiling continued. These processes should be repeated a third, and, if necessary, a fourth, fifth, and sixth time, until a fairly cleansed residue is left. The deposit thus obtained may be calcined by the application of a strong heat if the objects are to be examined by condensed reflected light under the microscope; but this further process is unnecessary if they are to be mounted in a transparent medium, and observed with transmitted light. Thus prepared they will be freed from adhering extraneous particles, and will present the wonderful beauty and symmetry which has been outlined in Fig. 6.

* *Ut suprà*, p. 8.

* "The Anatomy of Invertebrated Animals," p. 87.

Now let us endeavour to show what relation these pretty shells hold to the bodies which have produced them. The reports of the *Challenger* expedition have shown that the *Radiolaria* of the great oceans usually live towards the surface, and that their skeletons, like those of the *Globigerinæ*, are being continuously showered down on to the bed of the deep sea from its surface waters. Unlike the *Globigerinæ*, however, the *Radiolaria* prefer to live in the temperate zones of the world; at about 55 deg. on either side of the equator the *Globigerinæ* commence to become meagre in size, and to gradually disappear, whilst the *Radiolaria* increase in numbers and arrive at their climacteric towards the circumpolar areas, where they are superseded by Diatomaceous plants.

The simplest form of Radiolarian is one which is common in fresh-water ponds, the sun-animalcule (Fig. 7), or *Actinosphærium Eichhornii*. This interesting creature, which has been carefully studied by Hertwig and Lesser,* may often be seen under the microscopes at Stand 756 in the Exhibition. The figure here given is reproduced from Mr. Bolton's well-known portfolio of drawings.

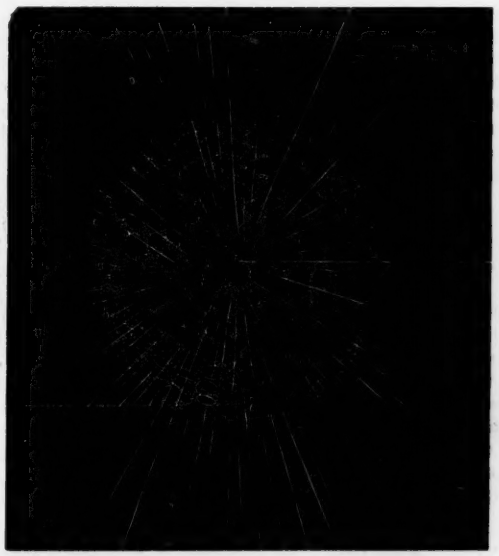


Fig. 7. *Actinospherium Eichhornii*. *c c c*, contractile vacuoles. (From a drawing by H. E. Forrest, in T. Bolton's Portfolio.)

The *Radiolaria* are provided with stiff, usually straight, but sometimes anastomosing pseudopodia, the coalescence of which, however, can be immediately separated at the will of the animal. The centre of the body possesses a dense, protoplasmic capsule, which sometimes contains only a globule of oil, and there are one or more contractile vacuoles in *Actinosphærium*, but not in the other forms. The pseudopodial protoplasm is everywhere studded with yellowish cellæform bodies, which are said to be composed of a material like *glycogen*, or animal starch, and it is in this layer also that the beautiful siliceous skeleton is elaborated. *Actinosphærium* does not generally possess any skeleton, but some of its allies are provided with spicules of siliceous matter.

Nearly all the *Radiolaria* are marine, of minute size, and simple; but there are a few which live together and form compound gelatinoid masses at the surface of the sea, such are *Sphærozoüm*, *Collosphæra*, and *Thalassicolla*.

* Ueber Rhizopoden, "Archiv für mikroskopische Anatomie," 1876.

In our next issue we propose to give a fully illustrated account of the beautiful and useful sponges which adorn many of the galleries in the Exhibition, to briefly point out their affinities, and to show the structural relationships which exist between the living tissues of these curious animals and the skeletons which are so much prized, both for domestic purposes and as ornaments.

(To be continued.)

FLIGHT OF A VERTICAL MISSILE.

By RICHARD A. PROCTOR.

PROP.—*A body is projected vertically to a height*, h, *in time* t_1 *(resistance of the air neglected). If we sum up all the westerly deflections due to the difference between the eastwardly motion at points above the earth's surface, and at the surface itself, what total westerly deflection do we obtain? and how is the difference between the westerly deflection so obtained and the real deflection to be explained?*

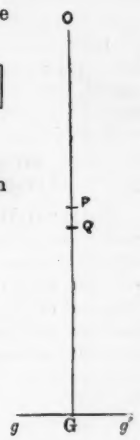
Consider only the fall of the body; since manifestly the westerly deflection obtained in this (incorrect) manner, will be the same for the rise as for the fall.

Let O be the point from which the body falls, gGg' the ground, $OG=h=\frac{g}{2}t^2$.

Let the falling body be at P after time t, then $OP=\frac{gt^2}{2}$, and $GP=h-\frac{gt^2}{2}$. In time dt the body at P is carried eastward with the eastwardly motion of G, while the point P vertically above G is carried eastwards with the greater motion due to the height of P above G. The motion of G in time dt is $\frac{dt}{P}\cdot 2\pi r$ (where P is the earth's rotation period, and r the earth's radius). Therefore the westerly deflection in time dt—

$$=\frac{dt}{P}\left[2\pi\left(r+h-\frac{gt^2}{2}\right)-2\pi r\right]$$

$$=\frac{2\pi}{P}\left(h-\frac{gt^2}{2}\right)dt$$



Consequently, the total westerly deflection during the fall,

$$=\frac{2\pi}{P}\int_0^{t_1}\left(h-\frac{gt^2}{2}\right)dt$$

$$=\frac{2\pi}{P}\left[ht_1-\frac{gt_1^3}{6}\right]$$

$$=\frac{2\pi}{P}\left[ht_1-\frac{ht_1}{3}\right]$$

$$=\frac{4\pi h}{P}\frac{t_1}{3}$$

or total westwardly deflection during ascent and descent,

$$=\frac{8\pi h}{3P}t_1.$$

Let us try this problem another way. Put O P$=x$, P Q$=dx$. Then time of falling through P Q$=\frac{dx}{\sqrt{2gx}}$; and during this time the body gains a westerly deviation corresponding to the excess of the eastwardly motion of the

point x over that of the point G, during that interval; or

$$\left[\frac{2\pi}{P}(r+h-x)-\frac{2\pi r}{P}\right]\frac{dx}{\sqrt{2gx}}$$

$$=\frac{2\pi}{P}\frac{h-x}{\sqrt{2gx}}\,dx$$

$$=\frac{2\pi}{P\sqrt{2g}}\left(\frac{h}{\sqrt{x}}-\sqrt{x}\right)dx$$

∴ total westwardly deflection

$$=\frac{2\pi}{P\sqrt{2g}}\int_0^h\left(hx^{-\frac{1}{2}}-x^{\frac{1}{2}}\right)dx$$

$$=\frac{2\pi}{P\sqrt{2g}}\left(2h^{\frac{3}{2}}-\tfrac{2}{3}h^{\frac{3}{2}}\right)$$

$$=\frac{8\pi h^{\frac{3}{2}}}{3P\sqrt{2g}}=\frac{4\pi h}{3P}\sqrt{\frac{2h}{g}}=\frac{4\pi h}{3P}t_1$$

or westwardly deflection during ascent and descent

$$=\frac{8\pi h}{3P}t_1$$

as before.

The real deviation, as shown at pp. 10, 11, is twice as great. The error manifestly arises from our not taking into account the fact that gravity does not act throughout the flight at right angles to the course which the body originally possessed in a horizontal direction. In our next we shall consider the problem analytically with due reference to this point, which, though it may seem slight, really causes the deviation to be twice as great as it would be were the directions of gravity on the falling body parallel throughout the flight.

A CONTEMPORARY says that by a recent analysis of tobacco-smoke, MM. G. Le Bon and G. Noel have extracted bottles of—(1) Prussic acid; (2) an alkaloid of an agreeable odour, but dangerous to breathe, and as poisonous as nicotine, since one-twentieth of a drop destroys animal life; (3) aromatic principles, which are as yet undetermined, but which contribute, with the alkaloid, to give the smoke its perfume. The alkaloid appears to be identical with collidine, which has been observed in the distillation of many organic substances, but its physiological and poisonous properties have been hitherto unknown.

FLOATING DOMES FOR TELESCOPES.—The Paris Observatory, requiring for a new telescope a dome 20 mètres, or rather more than 65 feet 7 inches in diameter—the size of that of the Pantheon—it was resolved to accept a proposal of Eiffel to make it float in an annular tank, to be filled with water containing chloride of magnesium, to prevent its freezing in the winter. This being mentioned as quite a novelty in a Report of the Observatory issued in February, M. Merten explains in *Ciel et Terre* that a floating structure was proposed by Van Rysselberghe in 1880, and accepted in May, 1882, for the new Observatory in the environs of Brussels, with some improvements in detail devised by MM. Royers, engineers to the city of Antwerp. There is to be an annular tank, filled with a mixture of three parts of water and one of glycerine, and in it a float of corresponding shape, carrying a cylindrical superstructure, with a sliding-roof opening half way. By a simple mechanism, the whole cylinder will have a revolving motion, and also be capable of elevation and depression, so that when required the telescope may be completely uncovered.

Editorial Gossip.

READERS of KNOWLEDGE may, perhaps, be interested to learn how pleasantly and successfully the holiday lectures, which began with my course of six at St. Leonards-on-Sea, are progressing. We have begun with the south-east of England, and are working steadily westwards and northwards at present, though it is probable that we shall return to some of the places where we have been most agreeably greeted. At present (Saturday, July 14th) thirty-five of these summer lectures have been given at St. Leonard's-on-Sea, Tunbridge Wells, Eastbourne, Worthing, Folkestone, Brighton, Dover, Deal, Portsmouth, Ashford, and Chichester.

ALTHOUGH I have been pleased, and even surprised, considering the season, at the welcome given me at all these places, I have had to note at some of them—especially at Chichester, Ashford, and Deal, a rather amusing slowness of apprehension, not in those who have come to the lectures, but in those who have not come. I get multitudes of letters after I have left a place, telling me how gladly the writers would have come to the lectures if they had known that they were so easily to be understood even by persons not much acquainted with astronomy. They find this out rather late, considering I have lectured now for nearly fourteen years, and always on the same plan. Then they ask me to return, either repeating my lectures or giving others of the series. But of course it is precisely to the places where these erroneous ideas have prevailed that I am least likely to return. I might possibly, at a second visit, see those who, "had they but known," &c., as they write, would have attended the first series; but though that might suit them, it would be very inconvenient to me. It is not only as easy to address a thousand as to address five hundred, but far easier—to say nothing of the circumstance that if the thousand divide into two audiences of five hundred, all expenses are doubled.

THEN, as to time; we calculate that to work through England and Wales, Scotland, and Ireland, as we propose to do, will take not less than two years, and that is all the time I can spare. I put off my return to America till the autumn of 1885, but I can put it no further off. Therefore, though exceptional success may encourage me to return to certain places, or to give more lectures than I had originally intended, it is impossible for me to make two visits to places where half of those who wish to hear me only find out their wish after I have left.

IN the last number but one appeared a short extract from the *Spectator* (from the pen, I imagine, of Mr. Richard H. Hutton), headed "God's Will." This has caused some correspondents to send me a few very singular letters. When I receive a single particularly foolish letter on a subject, I generally assign it to some "local lunatic" who has been unwisely entrusted with pen and paper. But when several such letters appear, I begin to think there is some reason for their writers' mistakes. Yet in this case, what *can* be the reason? A writer thoughtfully propounds anew the old, old mystery, the existence—nay, the general prevalence—of evil. Stating at the outset his belief that God governs as well as reigns, he shows what a mystery God's government is. He points to the vast, unending, inexplicable waste of life, to the miseries endured by too many of those who live, and shows that for us there is no solution to the awful problem. On this, there fall

upon him and upon me certain feeble-minded folk, who think they do good service by offering God the unclean sacrifice of falsehood, who tell us there is no mystery, there need be no evil, there should be no sorrow. They quote words from the Bible, words which really mean precisely what was said here, only they mistake "resignation to an inexplicable Will" for recognition of what that Will may be. Their appeal is to Cæsar, to Cæsar let them go. *Is* there no evil, and need there be no sorrow? Where, then, is it written that "man is born to sorrow as the sparks fly upward?" *Can* we, in truth, by study recognise God's will, can we see its perfection? Where, then, is it written: "Canst thou by searching find out God? Canst thou find out the Almighty unto perfection? Higher than heaven what canst thou know? Deeper than hell what canst thou do? As touching the Almighty, we cannot find Him out?" We can but believe, we cannot know, for "knowledge is of things we see," and God—we know—is "more than they."

SOMEONE forwards me, apparently for notice, the following extract from the *Northern Whig* (Belfast):—

"For some time past scientific men have pointed out that the fixed stars are not fixed at all, but move in a manner peculiar to themselves. Mr. Proctor ascertained with a great degree of accuracy that Beta, Gamma, Delta, Epsilon, and Zeta, the well-known group in the Great Bear, were all drifting at the same rate in the same direction, and now the recession of Sirius has been proved to be a fact. The cause of these movements is a mystery, but Mr. Proctor does not hesitate to apply in an extreme manner the experiences of Mr. Adams and Le Verrier (A.D. 1846) in regard to the discovery of Neptune. He inclines to the belief that there is in every instance a disturbing body, and in the case of Sirius this must be as large as that great star itself (much larger than the sun). It follows that if this companion body be a star we should see it. Mr. Proctor and some others, however, declare that such a body must exist, and that, as it cannot be seen, it is, therefore, a dark orb. This being the case, all that it is necessary to do to find its whereabouts is to conduct calculations similar to those of Adams and Le Verrier, and by such means ascertain the exact position of the dark companion orb. This has been done in other cases under similar conditions, but as yet without success. Mr. Proctor, however, thinks the principle is a sound one. If so, we have a peculiar state of affairs, viz., that not only are there stars scattered in myriads like diamond dust on the face of the heavens, but that, in addition, there are also thousands of dark stars that move with their glittering companions, but do not shine, and are not seen.

Considering (1) that Sirius's thwart motion long since indicated the presence of a companion, and that the position of the theoretical companion agreed fairly with a visible companion discovered by Alvan Clark; (2) that the calculations had not the least resemblance to those made by Le Verrier and Adams; (3) that the recession of Sirius was demonstrated a dozen years ago; (4) that *now* it is not the recession, but the surcease of recession, which is in question; and (to make a long story short) that I hold, and have expressed, not one of the opinions ascribed to me in the latter half of the above passage (but only that where there *is* a disturbing body the spectroscopic method may serve to indicate its presence), the paragraph may be described as first-rate for *news*. Unfortunately, there is more news than truth in it.

THE new series of the *Cornhill Magazine* affords a melancholy example of the effect of putting new wine into an old bottle. The old bottle is burst,—the *Cornhill* of Thackeray and Leslie Stephen is "gone, positively gone." Very little has been left of the *Gentleman's Magazine*, under the new story-telling *régime*, but of the *Cornhill*, nothing at all remains except the cover. The illustrations of the Model Story would discredit the pages of *Bow Bells*.

THE FACE OF THE SKY.

FROM JULY 20 TO AUGUST 3.

BY F.R.A.S.

THE usual watch should be kept on the sun on every clear day. The night sky will be found delineated in Map 7 of "The Stars in their Seasons." After the 22nd twilight will cease for an interval, gradually increasing every night. For all practical purposes there is not a single planet at present visible; nor will the moon occult any stars during the 14 days to which these notes refer. The moon's age at noon to-day is 15·9 days, and so on until August 2, when it will pretty evidently be 28·9 days at the same hour. At mid-day on August 3 it will be 0·4 day. Hence, after about July 26, she will be inconveniently placed for the ordinary observer. About midnight to-night (28th) she will cross from Capricornus into Aquarius. She will remain in this last-named constellation until noon on the 23rd, when she will travel into Pisces. She will occupy the next three days in traversing this constellation, which she will not leave until 3 p.m. on the 26th, passing then into Aries. About 7 a.m. on the 28th she will enter Taurus. About 7 p.m. on the 30th her path will carry her into the northern part of Orion. She will occupy some twelve hours in crossing this, and then emerge into Gemini. There she remains until midnight on August 1, when she travels into Cancer. She crosses this constellation during the 2nd and part of the 3rd, entering Leo about 4 p.m. on that day. We there leave her.

SOMETHING ABOUT THE BEET.

(*Continued from page* 29.)

THE richness of the juice in the sugar is the greater as the juice is thicker; and the smaller-sized roots generally give the thickest, and therefore the richest juice. Still, this is not an absolute rule as yet, though we may some day show that it is.

The most satisfactory results are obtained with beets weighing 200 to 300 grms.; those weighing 300 to 400 grms. are a little inferior, and in all above this the percentage rapidly declines.

For every 100 kilos. of sugar there are from 13 to 14 kilos. of ash, consisting of alkaline and earthy phosphates taken up from the soil.

A substance which resembles *diastase* may be obtained from beet, but the examination of it at present is very incomplete.

The *Mammoth* variety appears to yield the largest crop, and the *Imperial* to yield the greatest percentage of sugar.

The specific gravity of seed taken immediately after gathering is a direct measure for ascertaining the amount of sugar present in the root, but as this is attended with a good many difficulties when employed for the purpose of choosing the roots for seed, the following is a better plan:—Cut pieces out of the roots about a third from the top, and place them in a bath of salt about 105°, and only those roots the cuttings from which sink should be used for seed.

Good seeds should have a germinating power of not less than 85 per cent.; this will depend in a great measure on the ripeness of the seed when gathered.

Germination begins between 6° and 7° C., and it takes about twenty days at this temperature to make them appear above ground. At less than 6° the growth is arrested to recommence again when the temperature rises. For this reason beets should be sown in April. In the beginning of the month the mid-day heat is alone useful, and, as it does not penetrate deep into the soil, the seeds should be sown shallow. They also require much moisture, and, if sown deep or too early, the tender shoots are unable to pierce the thick layer of earth which covers them.

Good results are obtained by steeping them in liquid stable manure for 48 hours, and afterwards gathering the seeds up in large heaps, and allowing them to heat sufficiently to start germination. In five or six days the radicules will appear, and the sowing should then be immediately proceeded with, and in less than a fortnight, if sown in the middle of April, there will be a well-grown crop of seedlings.

It is, on the whole, far better to plant sprouted seeds. They appear above ground sooner, and, besides the start which they get by doing so, it saves them from the insects which injure them when tender, a bottom layer of chemical manure, about ½ to 1½ cms. deep, helps their progress (a mètre = 39·37 English inches, and contains 100 cms., *i.e.*, centimètres.)

The choice of soil, manures, and other conditions for the growth of the beet are similar to those required for the potato, and as both require the avoidance of a late vegetation, no better instructions can be given for the beet than those followed for the potato.

XUM

I can but refer very briefly to the results of the manuring experiments, but as they are in most parts similar, as I said before, to those needed for the potato, this will, I hope, be excusable. But I have already taken up so much of the editor's space, that I am afraid he will be "hauling in the slack" if I do not stop very soon.

The French sugar manufacturers prohibit the use of nitrate of sodium among the growers of beet, presumably on account of beet absorbing such large quantities of nitrates from the soil. In fact, it is thought that the food of an animal kept on English beets manured with this salt would contain such an amount of nitre as would be really injurious!

It is better to apply artificial manure containing nitrogen-phosphates and potash in a soluble form shortly before the seed is sown.

Beets which contain the most sugar are poor in nitrates; hence nitrates decrease the yield of sugar.

There is a parasite called *Heterodera Schechtii*, which causes a failure in the crop; before this fact was discovered, the failure was put down to absence of potash and poorness in the soil.

The potash of charcoal residues is in a form which can be more readily absorbed by the beet than the potash of molasses beet. Phosphates and guano give very favourable results as regards the percentage of sugar in the yield. Lime from sugar works is better for the sugar manufacturer, as manure, than the mixture of lime with distillery residues.

Avoid slow working manures, for it must always be borne in mind that all delays which prevent the plant from reaching its full growth are at the expense of the saccharine matter of the roots; they go on growing and taking up salts from the soil which they have not power to assimilate. Phosphates are most favourable when applied in the spring.

Stable-dung, when applied to the fields in the autumn, yields very good results both in quality and quantity. The use of phosphates, with Chili saltpetre, gave very favourable results—such good ones, in fact, that it is thought that farmers would do wrong to continue the use of nitrogenous manure alone. Two parts of Chili with three of superphosphate is a good mixture, but the best mixture of this must be deduced from future experiments, for which we must wait until we see the reports of the work now being carried on.

Another good mixture is 20 kilos. of phosphoric acid and 10 kilos. of nitrogen manure.

This, I hope, is enough new matter for the consideration of your readers, without my going into further details on this, at least to me, very interesting subject. F.C.S.

A CORRESPONDENT of the *Nebraska State Journal* writes: "I wish I could give you a description that would do justice to a railroad I rode on in Oregon. There used to be some coal-mines up at Coquille City, and a wooden tramway was run up from the head of Coos Bay. The mines gave out, but the tramway was left. I heard there was a railroad, and when I got there the train had backed up to the end of the track. Well, you would have died to see that train of cars. The old man who had appropriated the tramway had got an old engine out of the mine and mounted it on a hand-car, and connected the driving-shaft with the handle. This was the engine and tender. The baggage, mail and express cars, and the passenger coaches were comprised in two rubble cars, such as are used in the section for carrying tools, rails, &c. The old man was a no less wonderful combination than the train. He was the company and the working force of the road. President, vice-president, stockholders, agent, conductor, engineer, fireman, and peanut boy were all comprised in his lank form. He never had any trouble with the stockholders, and he carried the general office in his hat. My fellow passenger raised an umbrella when he got on board, and on my inquiry as to the need of an umbrella, said I had better raise mine—I would need it. When the train started I found out he was right. The puffing, wheezy old engine sent soot and water over us in a perfect shower. We got along, however, very well, and would have made the trip as quickly as we could have walked it, if the train had not stopped when we were about half way, and waited half-an-hour for a man who wanted to go with us to finish his supper."

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

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FLIGHT OF MISSILES.

[874]—As to the westward deviation of a vertically discharged projectile caused by the rotation of the earth, Mr. Bray's investigation seems at first sight to be demonstrative, and, from its ability, thoroughly deserves to be so. Probably he has by this time discovered the deficiency therein. Let a mean always the place of discharge on the earth's surface, whatever position it may occupy in absolute space. We are on the equator, and η Virginis is in the zenith at the instant of discharge; so that our vertical at that instant is in the direction of $a\eta$. Now, Mr. Bray has taken into consideration only that the eastward angular movement of the vertical round a leaves $a\eta$ and the projectile to the westward; he has overlooked that this same movement brings the centre of the earth and the direction of gravitation to the westward of the downward prolongation of $a\eta$, and that therefore the projectile must be, at any time after discharge, not only west of the vertical, but, even more, westward of $a\eta$. I believe that he is better able than I am to complete his calculation by the introduction of this element.

If t be the whole time of flight, your formula for the deviation, δ_λ, of a projectile, due to the height attained and the time of flight, becomes $\delta_\lambda = \frac{8\pi}{3}\frac{t}{P}h\cos\lambda$. It is quite easy to make out the formula for the deviation, δ_r, due to the range attained and the time of flight, which is $\delta_r = 2\pi\frac{t}{P}r\sin\lambda$; the former deviation being always to the west, the latter in northern latitudes to the right. Substituting for h its value from the theory of parabolic trajectories, $\frac{v^2\sin^2\epsilon}{2g}$, and for r, $\frac{2v^2}{g}\sin\epsilon\cos\epsilon$ (v being velocity and ϵ elevation of discharge), we have $\delta_\lambda : \delta_r :: \tan\epsilon : 3\tan\lambda$. Whence follows the interesting but not generally known result that in firing due N. in northern latitudes, when the two deviations are in opposite directions, if ϵ be selected so that $\tan\epsilon = 3\tan\lambda$, they will be equal and will annul each other. Thus, if the resistance of the air were absent, a shot fired N. from Westminster Bridge at the elevation of 75° 9′ would have no deviation from the rotation of the earth.

M. H. C.

BINOCULAR VISION.

[875]—My first letter having elicited comment, as I hoped, I beg to be allowed space for a few words in reply. I marvel much at some of the contents of Mr. Browning's criticism. Of course, I accept his statement of spectacles with unequal lenses being comfortably and satisfactorily used in a case of disparity of vision between the right and left eye of the wearer. But I take leave to observe that, in the case referred to, the linear disproportion (40 to 16) is only as 2½ to 1, whereas in my case (36 to 5) it is more than 7 to 1. No just parallel can, therefore, be drawn. As to the mistake with which he credits me, I remain unconvinced; he quotes my opinions as being that two "well-defined images of different dimensions will [not coincide and coalesce"; whereas I used the word "immensely" before different, which is immensely different. The example which he gives of a penny and halfpenny seen in the "stereoscope" [misprinted "spectroscope"], is, similarly, not a case in point, the disproportion between the coins not being sufficiently marked. Had he made the experiment, say, with a crown

piece and a threepenny bit—well, I should have required rigid proof. Even as to the image midway between the size of the bronze coins, I don't quite see where the demonstration [Qy., explanation R. P.] comes in, or how it can be obtained.

Now, as regards Single Vision No. 2 and yourself, I am somewhat uncertain as to the precise fault found with me; and it would seem as if some definitions of terms were needed, for which I am, perhaps, responsible. I must therefore define that by "distinct dual vision," I did not mean distinct vision by both eyes in unison; but two distinct images, one with each eye; and further, that by "single vision" I mean one image, with one eye, exactly as if the other were closed or non-existent. With this explanation I distinctly re-affirm my proposition, adding that it is based on my own personal sensations and experience—inasmuch as, under certain conditions, and in a medium position, where the images formed in my two eyes are equally blurred and indistinct, I do, as a matter of fact, see two different images—of course, of equal size.

In conclusion, sir, permit me to remark that, as I have had a mathematical education, been assistant in an astronomical observatory, and aided theoretically and practically in calculating the radius of curvature for lenses, and grinding and polishing to correspond (in making object glasses for refracting telescopes), "Single Vision No. 2" has made a bad shot in assuming that optics are unfamiliar to

SINGLE VISION.

[The difference between my own eyes is very nearly as great as between "Single Vision"'s, my left eye being very shortsighted indeed (I can see distinctly with it at a distance of two inches) while my left eye sees distant objects with perfect distinctness. Yet I see an object clearly and singly when the shortsightedness of the left eye is corrected by a suitable convex glass. Has "Single Vision No. 2" altogether missed? "Single Vision" seems to imagine the disproportion in size between the two images, when the sight of his shorter eye is corrected, is as 7 to 1 linear. If he will consider the matter, he will find, without having occasion to calculate curvatures or to grind or polish lenses, that no such difference exists; and that such difference as does exist, does not depend on the shortness or length of the sight of either eye—that is, it does not depend on the distances for distinct vision.—R. P.]

WARTS.

[876]—If you will allow me, I will add my experience—though fifty-five years ago—to what you have already inserted as to wart-charming. I enclose my card, for only private use, and I think the paper on which this is written may give a healthy colour to my veracity. My warts were counted exactly as described by "Puzzled Sceptic." Two or three were so small that, not being quite sure whether they were warts or not, they were *not* counted. The person said to be able to charm them away was a woman in the village in Yorkshire close to where I was born, and who had been my wet-nurse. At the time in question I might be about twelve years old. Having tried caustic, silk, and other household remedies unsuccessfully, I let her try. Whether, at that age, I had any belief in success I do not remember, but I am sure I did not trouble myself much about it. She said they would all be gone in three or four months. As a matter of fact, I have to state that by the end of that time the sole and only warts remaining were those which had not been counted, and had afterwards developed themselves. I have the mark of a very large one, which had two or three heads, upon one of my finger joints still. Being of an inquiring mind, I several times asked "Jane Watson" what she had done. For some time she refused to tell me. At last, being pressed by her "foster-son," she first extracted a promise from me (which I fear I have not kept) that I would not divulge her secret. Upon this she confided to me that she had taken a piece of worsted, and made as many knots in it as the warts that were counted. That she had buried it under a gooseberry bush in her garden, and, whilst doing so, that she uttered the following incantation, viz.:—

"Pray, Lord, as this rots and decays away,
To take Master Robert's warts away."

And now, having stated bare facts, I say no more. I know no more; but so it was.

R. W. J.

Royal Institution, *June* 6.

[It seems likely that the charmer as well as the charmed should have full faith, in order that the right sort of mental influence may be produced. The effective action of the mind seems exerted while the counting is going on.—R. P.]

AN ENIGMA.

[877]—A very curious method of calculation for discovering any person's age having come under my observation, I think it sufficiently ingenious to be worthy of notice in your important paper. The system is as follows:—The person whose age you want to discover is requested to write down, privately, the day of the month he was born and the month of the year, then you ask him to multiply by two, add 5, multiply by 50, add *the age*, and subtract 365. You then ask him for the total, to which you add 115, and the result will show the day of the month, the month of the year, and the age.

The following is an example worked out. Supposing the person's age is 20, and he was born on the 5th of January—

```
                5,1
                  2
               ----
                102
                  5
               ----
                107
                 50
               ----
               5,350
                 20
               ----
               5,370
                365
               ----
               5,005
Then add—        115
               ----
               5,1,20
```

5th day, 1st month, 20 years of age.

Can any of your readers explain this, to me, strange arithmetical enigma?

C. HOLLIS CHALLEN.

[Let us consider what you do with the numbers in question, and we shall probably find an interpretation of the puzzle. Let n be the number for the day, N for the month, A the age in years. Note next that multiplying by 2, adding 5, and then multiplying by 50, is the same as multiplying by 100 and adding 250; while subtracting 365, and then adding 115, is the same as subtracting 250; so that these four operations together are equivalent to multiplying by 100, or adding two cyphers to the number first taken, which is $10n + N$. As the only other operation is adding the age, it is not very wonderful that we get the three numbers we wanted,—provided always that N is not greater than 10, nor A than 100. Thus, if you take 3, 7, and 15, multiply 37 by 100, and add 15, you naturally get 3,715.—R.P.]

GINGER-BEER PLANT.

[878]—Perhaps some readers of KNOWLEDGE could help me by explaining the following facts:—

A member of our family, while out visiting lately, brought home what her friends called a "ginger-beer" plant. The plant (as we will call it) consists of numerous small bottle parts (separate) about the size of a pea, and somewhat resembling tapioca when it has been soaked. The mode of making the "ginger-beer" is to put a certain quantity of ginger (whole) into a good-sized bottle containing some of the "plant" and filled with water, and then to sweeten with a little sugar a short time before taking the "ginger-beer" out of the bottle.

During the *making* of the "ginger-beer," the plant shows strong effervescing powers (sometimes sending large pieces of ginger to the surface of the water).

The "plant" has to be separated every three weeks, by which time it will have doubled itself; and if not separated would burst the bottle, if the "ginger-beer" was not removed very frequently. The "ginger-beer" can be strained off about twice a day; and, although I have not tasted it myself, I am told it much resembles the bottled ginger-beer, but does not have the "gasey" taste which characterises the latter.

T. H. PERRY.

INTELLIGENCE IN AN ANT.

[879]—I witnessed, the other afternoon, a very remarkable case of intelligence in an ant. I was sitting on some grass by the side of a small path, just in front of me being a short stone step, when my attention was drawn to two separate streams of ants, one going from me up the path, the other returning, carrying back with them their food. Among these little scavengers returning was one with a load much too heavy for him, so when the step was reached, over which all the ants had to pass, this busy worker dropped its burden, and then went over himself and got possession of it again. I expected he would proceed with the others, but instead of this he had a very laborious climb back again with the food, and then again dropped it over the step. The same thing was repeated three times, but at the third attempt I cut the piece of matter in two,

XUM

hiding one half, and watched to see if the former actions were repeated; but the ant, having now an easy load, followed the others, and was lost in the grass.

I came to the conclusion that the ant showed a great amount of reasoning power in dropping his load over the step so many times, as it was evidently his aim in doing so to break up his heavy burden, so that he might find locomotion easier with a smaller piece.

H'SETT.

LETTERS RECEIVED AND SHORT ANSWERS.

B. Y., Belfast. "The course of nature is perfectly invariable"—quite so; only what we want to determine in this matter is, just what that invariable course of nature may be. "Such things as 'Mrs. Croad's state' never ensue." The *Spectator* never said they "ensued"; possibly because the editor in the *Spectator* can write decent English. "Dr. Carpenter, mental matters regarded, is quite unreliable"; well, this is not the usual opinion; yet if it were, I should be disposed to rely considerably more on his opinion than on that of an obviously illiterate and illogical anonymous writer. Your last remark that "such statements must injure KNOWLEDGE, and if they do not, damn it, they ought to do so," sounds profane; but possibly there should have been no comma after "not"; if so, I must fain tell you, my dear sir, you resemble that friend of Artemus Ward's, who "coodn't punktooate wuth a cent."—AN OLD WOMAN. Thanks for your thoughtful letter. I think you overlook the circumstance that the forethought and care on which—as you truly say—the tenure of life depends, would themselves be regarded by the *Spectator* writer as part of "the policy" of Deity. The mental and moral qualities of men are as essentially natural gifts as their bodily characteristics. If it could be shown—though I must confess it seems a hard saying—that the Sunderland catastrophe was, as you say, "the result of folly," still that folly and the ignorance, greed, and carelessness of which you speak, are no more to be blamed on those who, as you say, inherit these qualities than the children themselves were to be blamed for yielding to the law of gravity on that fatal stairway. In other words, all you say leaves the great mystery where it was.—CANES VENATICI. Thanks. But I fear the readers of KNOWLEDGE ought not to be provided with a picture and description of your 13½ in. Newtonian merely because "only a small dozen in Southampton know anything of science." Suppose the whole of that small dozen appeared in the Philharmonic Hall, and that as many as ten of them bought KNOWLEDGE on account of its being thus made "doubly acceptable," would the 1s. 8d. so received (the gross amount) go far towards the expense of drawing and engraving a photo of your 14 ft. Newtonian from a 6 in. by 4 in. photograph?—E. POWELL wishes to know where he can get a copy of General Pitt Rivers' book on "Spring Traps."—J. M. HARTINGTON. No; I can suggest no remedy for a "blotchy skin," supposing you have already tried regular living; but perhaps you have not. If so, there are still hopes for you.—AN ASHAMED SUBSCRIBER, U.S. If I could make out your object in writing, I should know why you are ashamed; as it is, I see no particular reason, except, perhaps, that you omit to send your name. Are you ashamed of *that?* The remedy is obvious. The verselets implying that God rules Nature are sound in thought, though in a literary sense feeble. But how they bear on anything in KNOWLEDGE, or why they should be inserted to tell readers what every one knows, passes *my* knowledge.—J. A. Nay, that would be asking the sellers of that article to advertise it here "free, gratis, for nothing."—E. WOOLLEY. Cannot give such details; they would occupy too much space, and be no news to most readers. Fear we are not likely soon to have space for the subjects you kindly suggest.—J. LAMBERT HALL. The error in last trick was not in proof. In note on trick 11, read for trick 11 trick 10, and for trick 12 trick 11.—G. JORDAN. I said that every month the moon is half the time north of the celestial equator. Will it remove your difficulties if I remark that for the other half she is south of the celestial equator? You ask, in particular, whether the moon ought not in Australia to rise and set in June to the north of east and west. By no means, if being full she is not too full and knows what is fitting for her to do. When the moon is full in June, she is, of course opposite the sun; and the sun being at his farthest north of the celestial equator, the moon is at that time at her farthest south of the same circle. Consequently her position is the same, or very nearly the same, as that of the sun in December, and naturally she rises and sets when full in June as he does in December, on the southward side of east and west in the southern hemisphere. I foresee that if I stop just here, you will ask how the moon can be seen in June in the Arctic regions if she is behaving thus in the southern skies, and should I fail to explain this, you will, I fear, rush incontinently to the flat earth theory, which seems to have such charms for you. Well, then, to start with, though the moon can be seen in the Arctic regions in June, she cannot be seen in June *when full*. If you will bring me a sailor (not too utterly full, or too foolish to remember what he has seen) who shall tell me that he has seen the full moon in June in the Arctic regions, then I shall be able to show you a full-fledged specimen of the genus "liar." In conclusion, let me inform you that the behaviour of the moon in any given latitude in the southern hemisphere is precisely the same as her behaviour in the same latitude in the northern hemisphere, only that what she does in January, February, March, April, May, June, July, August, September, October, November, and December in the northern hemisphere, she does in July, August, September, October, November, December, January, February, March, April, May, and June respectively, in the southern. Of this I needed no assurance before I had seen it for myself; but I have seen it for myself, so I know with the full assurance of eye-witnessing.—A. BARCLAY. Thanks; but your explanation, though sound, would not make the matter clear to that writer.—H. CLEMENTS. No space for planetary influences on weather. Try *English Mechanic*.—ELECTRICIAN. Thanks; but have at present no space.—FORGETFUL. Cannot say.—ISOBAR. The rainband spectroscope has been referred to in these pages. Klinkerfues' Weather Compass I have not yet seen.—W. DYER WARE, W. A. FELTON, and others. Cannot enter into details of that sort respecting Mr. Theobald's telescopes: it would form an inconvenient precedent.—JAS. MONTAGUE. Many thanks. But when mathematical problems were offered for solution such masses of MS. relating to them came in that it was impossible to deal with them. Consider the extra labour involved in deciding which solution is best among, perhaps, a hundred and thirty-nine.—R. E. W. Any bookseller would tell you who are the publishers of Sir G. Airy's treatise on the Hebrew Scriptures. I have the book, but am away from home.

SUB-EDITORIAL.

JAMES MENTEITH. For your "Newmoanier" a doctor would probably write an "inscription."—C. BOOTH. Such letters as yours do not reach the editor. He would probably not receive a very dreadful shock; still I prefer to act the part of an interposed buffer. "It is my duty and I will."—R. N. MELLIDEW, M. WILKINS, AN INQUIRER, SPIRIT WARNING, C. COLLINSON, RHYMING WILL, and many others. How *do* you suppose our editor chiefly employs his time? Or do you—perhaps—suppose he has nothing at all to do?

Our Mathematical Column.

GEOMETRICAL PROBLEMS.

By RICHARD A. PROCTOR.

PART VIII.

THE student must not always expect, however, to see so obvious a method of arriving at a maximum or minimum as in the preceding proposition. He must be ready to apply *tentative* methods. Take, for instance, the property established in the scholium to Ex. 8, and suppose we have the following problem:—

Ex. 10.—*Two points, P and Q (Fig. 15), lie on the same side of the line AB. It is required to find a point in AB such that the sum of its distances from P and Q shall be a minimum.*

We are supposed to know nothing of the property above mentioned. We should proceed, then, much as follows:—

Take the two points at very unequal distances from AB.* Draw PD, QE perpendiculars on AB. Then it is very obvious that the point we seek is not likely to lie outside DE. In order to *see* the sums of lines to D and E, produce PD to F, making DF equal to DQ and PE to G, making EG equal to EQ. Then it is obvious from the figure that PF is greater than PG; so that E *may* be the point we seek, but D certainly is not. But let us try intermediate points. Take C_1, and draw PC_1H, making C_1H equal to C_1Q. Then as drawn, PC_1H seems certainly not less than PG. Take C_2 nearer to E, and draw PC_2K, taking C_2K equal to C_2Q. We see that PK is obviously less than PG. Thus we learn that the point we seek lies between D and E, but nearer to E than to D. If we were not restricted as to the books of Euclid we were free to make use of, we might be tempted to guess that the point we seek might lie at distances from D and E, proportional to PD and EQ. This, indeed, would lead to the same result as we shall proceed to by another method. But we suppose the student limited to the use of Book I. He considers, then, what determinate point there can be in AB nearer to E than to D. He

* In problems on maxima and minima it is very important that inequalities of this sort should be sufficiently marked.

quickly rejects any points depending on the equi-division of the line. For instance, he cannot suppose that C E is *necessarily* a fourth part of D E; for since there is nothing to prevent P from being at the same distance as Q from A B, it is clearly not absolutely necessary that C E should be at all unequal to C D. The inequality

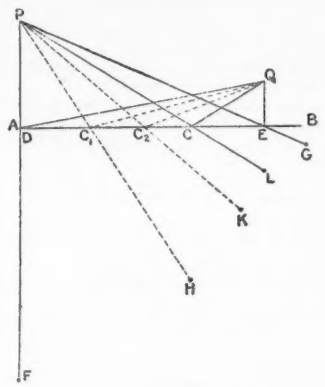


Fig. 15.

depends on the inequality of P D and Q E, and may naturally be supposed to vary with the extent of the latter inequality. Our student can hardly fail, we think, to light on the supposition that C ought to be so taken that the angles P C D and Q C E should be equal. He would try this, drawing now a new figure, as follows:—

Draw a line A B (Fig. 16), and from a point, C, in it draw C P and C Q, inclined at equal angles to A B, *and unequal*. Take another point, C_1, and join P C_1, C_1 Q. Produce P C, P C_1, to L and H, making C L, C_1 H, equal respectively to C Q, C_1 Q. Then we have to prove that P C_1 H is greater than P L.

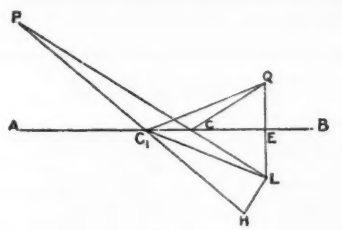


Fig. 16.

Join H L, then we should have to prove the angle P L H greater than the angle P H L. This does not seem very easy.

But next we notice that the angle L C E is equal to the vertical angle P C A (Euc. I. 15) and therefrom (*hyp.*) to Q C E. Also C L is equal to C Q and the triangle L C Q (here we draw in Q E L) is isosceles, C E being the bisector of the angle contained by the equal sides. Hence, C E is at right angles to Q L and bisects Q L in E. It is a very obvious consideration, at this point, that if we join C_1 L we shall have Q C_1 L an isosceles triangle, C_1 Q being clearly equal to C_1 L (Euc. I. 4). Hence, P C_1 and C_1 L together are equal to P C, and C_1 Q together. But P C_1, C_1 L together are greater than P L (Euc. I. 20). Hence P C_1 and C_1 Q are together greater than P C, C Q together. We find, then, that our surmise is correct, for what we have proved for P C_1, C_1 Q can be proved equally well wherever C_1 may be taken. Thus the problem is solved. It is not necessary to give the synthetical statement of our solution, since this has already been given in the scholium to Example 8.

It may be argued that such tentative processes as we began with, here, are not mathematics. To this it is to be answered—first, that the art of guessing well is an important aid to the mathematician; and secondly, that we deal with our guesses by means of mathematical reasoning, and thus gain all the benefit available from mathematical processes. But further, there are no *laws* for applying simple geometry—that is geometry resembling Euclid's—to deductions, and therefore in many cases we have no choice but to make use of tentative methods.

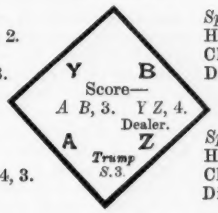
Our Whist Column.

By "Five of Clubs."

THE HANDS.

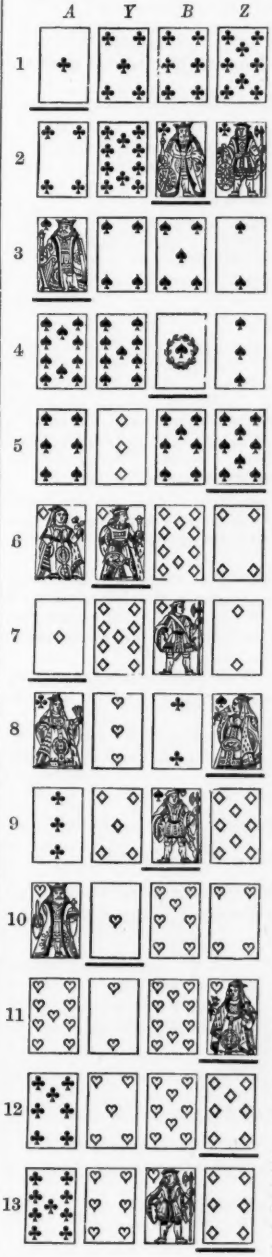
Y.
Spades—9, 4.
Hearts—A, 6, 5, 3, 2.
Clubs—10, 5.
Diamonds—K, 9, 5, 3.

B.
Spades—A, Kn, 7, 5.
Hearts—Kn, 10, 8, 7.
Clubs—K, 6, 2.
Diamonds—Kn, 10.



A.
Spades—K, 10, 6.
Hearts—K, 9.
Clubs—A, Q, 9, 7, 4, 3.
Diamonds—A, Q.

Z.
Spades—Q, 8, 3, 2.
Hearts—Q, 4.
Clubs—Kn, 8.
Diamonds—8, 7, 6, 4, 2.



NOTES ON THE PLAY.

NOTE.—The card underlined wins the trick, and card below leads next round.

1. Neither 4, 3, nor 2 appearing, someone is signalling unless *A* holds all three.

2. *A* leads the ante-penultimate, showing he held originally six in the suit. *Y* and *Z* hold no more, and *B* has signalled. Both points should be clear to all; the second, with *A*'s indication of six in suit, showing that neither *Y* nor *Z* holds the Queen. Hence affairs look well for *A* and *B*, *A* having established his suit, of which *B* holds a small card to return with, and *B* having either one honour five trumps, or two honours four trumps. (*B* is scarcely justified in signalling.)

3 and 4. *B* had four trumps, two honours. *A* returned his highest (he cannot hold the knave), and has but one more at most. *B* knows that *Z* holds the Queen and one more, but *A* may hold the 8, in which case *B* can clear out trumps, and if *A* has a re-entering card the game is won. But as it is obvious that if *B* leads trumps he will not probably be able to return *A*'s Clubs, he should have done this at once, forcing *Z* effectually. Therefore

5. *B*'s lead of trumps here is very bad. *Z* of course wins with the eight, and has full command; but

6. *Z* does not draw *B*'s last trump, for he sees that if he does, any re-entering card either in *A*'s hand or *B*'s, would enable *A* to make his long Clubs. *Z* therefore takes the only chance of saving and winning the game, leading the penultimate card of his weak long suit.

7. *Y* deems it better to return his partner's suit than to lead his own, seeing the value his Heart Ace has, first as a re-entering card, and second in keeping the control of the Heart suit for the nonce. If the King is with the enemy, leading the Ace will free it and give them the game. Though having four Diamonds originally, *Y* rightly returns the best of two left.

9, 10, &c. The rest of the game plays itself. *Y Z* make the odd trick and the game, though *A B* held two by honours, seven trumps, three aces, three kings, two queens, three knaves, three tens, and two nines.

XUM

Our Chess Column.

BY MEPHISTO.

Nuremberg, *July* 15, 1883.

WITHOUT being too sanguine, I think my previously expressed opinion has been confirmed by to-day's successful inauguration of the third congress of the West German Chess Association. The committee seem sincerely anxious to do everything in their power to render the sojourn of the players in this quaint old city as pleasant as possible. A very handsome suite of five large and lofty rooms, situated on the first floor of No. 1, Konigstrasse, has been secured for the meeting. The secretary and president, as well as the individual members of the committee, are very affable and friendly in their intercourse with the players, and altogether everyone is animated with pleasant excitement and a festive tone, a feeling that I, at least, never experienced on the fourth floor of the Criterion.

The entries, as will be seen, are more numerous than in the London tournament, and, putting aside the interest which is always attached to the play of Steinitz and Zukertort, I think on the whole more satisfactory.

The following nineteen players have entered the master tournament:—

Bird	London	Riemann	Germany
Blackburne	,,	Schottlander	,,
Gunsburg	,,	Löffmann	,,
Mason	,,	Schalloff	,,
Winawer	Warsaw	Bier	,,
L. Paulsen	Germany	Weiss	Austria
W. Paulsen	,,	Schwarz	,,
Bardeleben	,,	Hruby	,,
Lange	,,	Berger	,,
Fritz	,,		

Louis Paulsen needs no introduction; Weiss, Schwarz, and Hruby are very fine players; Weiss, having twice beaten Zukertort at Vienna, while Hruby has beaten English in a match. Of the names that might be new to English readers we mention Riemann, whose play is of a brilliant character. It will be remembered that Bardeleben won first prize in the London Minor Tournament. All the others are strong players. There are seven prizes in the master tournament, the first being £60.

A second tournament, with a first prize of £15, has also found favour among German chess players, no less than twenty-four having entered the lists, while a third tournament of sixteen is also being arranged.

In the chief tournament every competitor plays one game with another. Time limit is twenty moves per hour; the time of play is a severe trial to some who are fond of late to bed and late to rise. Play takes place at 8·30 to 12·30, and from 3 to 7. If possible, three games are to be played daily.

A problem tournament has also been held by the Association, and the winners will be declared at the occasion of a banquet to be held by the Association.

Play begins to morrow, and I think we may look forward to an exciting and interesting contest, which will produce some very fine play. MEPHISTO.

SOLUTIONS.

END GAME OF J. ROBEY, p. 16.

1. Q to R4 (threatening to win the Q by Kt to B7 (ch), for which reason also Black cannot play R takes Q)

	1. P to Kt3 (*a*)
2. Kt to B7 (ch)	2. K to Kt2
3. Kt to R6 and wins.	If Kt takes Kt, mate in two follows.
(*a*)	1. P to R3
2. P to Kt6	2. P to B4
3. Kt to B7 (ch)	3. R takes Kt
4. P takes R and wins.	

PROBLEM NO. 86, BY C. PLANCK, p. 16.

1. Kt to B8	K to K4, or		P to K7
		2. Kt to Kt6 (ch)	K to K6
2. P to B5 (ch)	K takes Kt	(*a*)	
B to Kt4 mate		3. Kt to B5 mate	

(*a*) If 2. K takes P., 3. Kt to Kt6 mate. Or, 2. K to Q5., 3. Kt K6 mate.

PROBLEM NO. 87, BY J. C. S., p. 16.

1. R to Kt3	K takes P, or		P takes P
2. R to Kt6	P or K moves	2. Kt to K4	K takes Kt
3. R mates		3. B to B6 mate	
		If 2. K to B5	3. B to K6 mate

ENDING, p. 32.

This proposition is not quite sound, but the method of winning is as difficult to discover as the way to draw.

First 1. R to Kt4 (K to R6. 2. R to Kt sq., K to R7. 3. R to Kt4; in order, therefore, to win, Black must play) 1. P to R6.

2. R to Kt5 (If K to R8, 3. R to Q5, and White will draw by perpetual check).

	2. R to R3
3. K takes P	3. K to R8
4. K to B6	4. P to R7
5. K to B7	5. R to R7 (ch)

The right move to prevent the draw. The KtP must be abandoned, but in such a manner that Black should gain a move.

6. K to B6 (If 6. K to B8, R to R8 (ch). 7. K to B7, R to KKt8 and wins)

	6. R to R8
7. R takes P (The winning move)	7. R to B8 (ch)
8. K to K7	8. R to KKt8

(The K being forced away first, and now the Rook next, enables Black to win.)

9. R to KR6	9. K to Kt7
10. R to Kt6 (ch)	10. K to R6
11. R to R6 (ch)	11. K to Kt6
12. R to Kt6 (ch)	12. K to B and wins.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

K. W. SHERRARD.—Problem received with thanks.

BERROW.—See solution. If 3. Q to R6 (ch), Kt takes Q?

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